Socioeconomic Determinants of Type 2 Diabetes in England

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Abstract

Background: The rise in diabetes worldwide and its significance as a cause of disability and premature death has increased the interest of researchers in diabetes mellitus. There is a large volume of published studies describing the role of factors such as income, poor education, inadequate housing conditions and unemployment as key social determinants in the development and progression of type 2 diabetes (T2D). This study therefore set out to investigate the main socioeconomic predictors of T2D in England.
Methods: Based on the available literature on the socioeconomic determinants of T2D, the variables, unemployment (long-term and short-term), overcrowding, income deprivation and no qualification were selected. Data on the socioeconomic determinants and prevalence of type 2 diabetes were retrieved online from the registry of the Office for National Statistics and the Health and Social Care Information Centre respectively. This was done specifically for the 64 randomly selected districts in England. Following preliminary analysis, multiple regression was conducted to ensure there was no violation of the assumptions of regression.
Results: Correlation indicates a significant moderate positive correlation between the prevalence of T2D and each of the variables: long-term unemployment, no qualifications and income deprivation, but no significant relationship with overcrowding. Multiple linear regression analysis indicates that long-term unemployment and no qualification were significant predictors of T2D in England.
Conclusions: The evidence from this study suggests that the prioritisation of resources, especially in periods of austerity and welfare reforms, to target these key predictors may achieve much in reducing the prevalence of T2D in England. Hence, it is recommended that a comprehensive data collection of these demographic characteristics are integrated into the existing process, and the collective effects of social, economic and biologic factors are investigated in future studies.

Key words: Type 2 diabetes, education, unemployment, income deprivation and overcrowding

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Introduction

In recent years, the rise in diabetes worldwide and its significance as a cause of disability and premature death has increased the interest of researchers in diabetes mellitus. In 2010, more than 3.1 million people in England aged 16 years and above were diagnosed with diabetes (NICE, 2015). While this seems extreme, based on WHO criteria, out of every seven people in England, one is likely to have impaired glucose tolerance or impaired fasting glucose (NICE, 2015). One particular form, type 2 diabetes (T2D), may account for about 90% of diabetes globally, and is caused by a combination

of genetic and environmental factors (Patel, Bhattachanya and Butte, 2010). Taken together, these current findings highlight the importance of this public health challenge.

Diabetes is a type of disease that has an extensive impact on the finances of individuals and their families, and on the national healthcare budget and economies. The long-term consequences of diabetes are significant, especially with increasing age (Alonso-Moran, *et al.,* 2014). An implication of this is the associated premature death, loss of production and need for informal care in individuals with T2D (NICE, 2015). According to Hill, Nielsen, and Fox (2013) structures in place to tackle the rising prevalence of type 2 diabetes are constrained in their ability to adequately take into account the influence of social determinants of health. Existing interventions are limited to addressing behavioural changes such as increasing physical activity and dietary modifications, and the management of the symptoms of diabetes as they arise. This is known to lead to temporary improvements in health outcomes (Walker *et al.,* 2014).

The present study does not deny that clinical interventions influence health; rather, it suggests that while advances in clinical interventions have improved health, they also have some limitations. A number of authors have examined these limitations. For instance, despite the creation of the Nation Health Service in 1948 and universal accessibility to health services in the UK, inequalities still exists in morbidity and mortality (Morris *et al*., 1988, in Braveman and Gottlieb, 2014, p. 20; Mackenbach *et al*., 1997; Mackenbach *et al*., 2008). As Walter *et al.* (2014) argue: "social determinants of health may provide a better understanding of why these lifestyle changes are not improving outcomes". The existing accounts of socioeconomic determinants and type 2 diabetes are focused on the relationships between only one of the socioeconomic determinants and T2D without taking into account other influences (Adler and Stewart, 2010). For example, in a study which set out to determine the effect of educational level on the development of diabetes found that the prevalence of diabetes was inversely related to educational attainment (Medalie *et al*., 1974, in Connolly *et al*., 2000, p. 177).

The lack of research quantifying the collective influence of the social determinants (income deprivation, unemployment, low education and overcrowding) on T2D precludes statements regarding whether these factors have a significant effect on the rising prevalence of T2D. Therefore, a study that establishes the collective relationship among the four aforementioned predictor variables on the prevalence of T2D in England will help in the development of population-based intervention programmes. It may also lead to a consideration of the impact of policies in these areas on the health of the population and any necessary reforms of social and economic structures that generate inequalities in health (Hill, Nielsen, and Fox, 2013).

METHODS

Data and methods

Based on the available literature on the socioeconomic determinants of T2D, the variables, unemployment, overcrowding, income deprivation and no qualification were selected (Brown *et al*., 2003; Chaufaun and Weitz, 2009; Pilkington *et al*., 2010; Touma and Pannain, 2011). Data on the determinants of T2D for 64 randomly selected districts in England were obtained online from the registry of the Office for National Statistics census data (ONS) (2011). It collects information on the entire population through pre-addressed questionnaires distributed nationwide either by post or by hand. The confidence interval was 95%, and the sampling error was minimised using statistical techniques such as the 'Coverage Assessment and Adjustment Process' (CAA) to provide information about individuals and households missed or those counted more than once. Further details regarding the ONS census 2011 design have been published elsewhere (ONS, 2012).

Prevalence of type 2 diabetes in England, was retrieved from a separate database, the Health and Social Care Information Centre (HSCIC) which has the responsibility for collecting data on the registrations, care processes, treatment targets and complication rates of diabetes in England and Wales (HSCIC, 2012). The HSCIC collects data from electronic patient records from general practices and secondary care outpatient data from the Clinical Commissioning Groups (CCG). The last-validated national diabetes audit, published in 2014 covering the years 2012-2013, was used in this study.

Ethical Considerations

The significance of ethical considerations in any study cannot be overemphasised. Thus, adhering to the professional standards of research is necessary

and should be reviewed before carrying out the actual study (Polit and Beck, 2012). This research study has adhered to the ethical guidelines provided by the University of Wolverhampton. This study accessed confidential information about the health and socio-economic status of people and hence there was a need to ensure that it is kept private. However, the retrieval, compilation, coding and analysis of secondary data in the public domain raised few ethical questions as there was no interaction with the individual respondents.

Study Variables

The variables invested in this study are as follows:

- Prevalence of type 2 diabetes: This is the proportion of the population with T2D, registered at a primary or secondary health care centre in England.
- Income deprivation: This is the proportion of the population living in income-deprived households relating to low income (<60% of the national median average income) (Public Health England, 2016).
- Overcrowding: This is the proportion of the population residing in households with one or more rooms less than required.
- Long-term unemployment: "Average number of monthly claimants of Jobseeker's Allowance who have been claiming for more than 12 months, expressed as a rate per 1,000 of the working age population" (Public Health England, 2016).
- Short-term unemployment rate: "Mean monthly number of persons who were claiming out of work benefit, divided by the population aged 16-64 and multiplied by 100, for less than 12 months" (Public Health England, 2016).
- No qualifications: Percentage of the population with no formal qualifications.

DATA ANALYSIS

All data analysis in this study was carried out using SPSS version 20. First, descriptive data were generated for all variables. After that, preliminary investigations were carried out for all variables. To ensure the independent variables are not correlated to each other (there is no multicollinearity) but correlated to the dependent variable (linearity), a correlation matrix and scatterplot were conducted respectively. To ensure the residuals in the model and sampling distribution are normally distributed, a histogram and a probability-probability (p-p) plots were generated. Next, the assumption of homoscedasticity is met for generalisation of the results generated from a sample population. This is achieved through the generation of scatterplots among the variables. Finally, a multiple linear analysis was conducted to examine the collective influence of these variables simultaneously on T2D.

RESULTS

The assumption of multicollinearity was assessed with a correlation matrix of all the variables. A Pearson's r data analysis reveals a strong correlation between short-term unemployment and income deprivation (r = 0.936, p = 0.000) and therefore are redundant. Hence, only one variable should be used in the final model (Field, 2013), see table 2 below. The correlation matrix conducted to explore the relationship between the independent and dependent variables can be seen in table 2 below. Significant results are in bold, identified as **where p <0.001. There was a significant moderate positive correlation between the prevalence of T2D and each of the variables: long-term unemployment, no qualifications and income deprivation. This indicates that as the levels of long-term unemployment, no qualifications and income deprivation increases in England, the prevalence of T2D also increases. The analysis however, did not show a significant relationship between the prevalence of T2D and overcrowding, hence it was excluded from the final regression model.

Table 2: Correlation matrix between socioeconomic determinants and type 2 diabetes (significant results in bold, **p <0.001)

	1	2	3	4	5
Prevalence of T2D					
Long-term unemployment	**0.563****				
Income deprivation	**0.454****	**0.803****			
Overcrowding	-0.013	0.074	0.235		
No qualification	**0.528****	**0.552****	**0.557****	-0.182	
Short-term unemployment (%)	**0.466****	**0.812****	**0.936****	0.046	**0.592****

To identify the significant socioeconomic determinants of T2D, a multiple regression analysis was conducted. The results were significant, F (3, 60) = 12.69, p = 0.000, R^2 = 0.388 suggesting that long-term unemployment, income deprivation and no qualification accounted for 38.8% of the variance in the prevalence of T2D in England. The other 61.2% of variance is explained by other factors not

included in the regression model. The individual predictors were examined further. No qualification was a significant predictor of T2D, B = 0.061, p = 0.011 suggesting that for every percent increase in no qualification, the prevalence of T2D in England increased by approximately 0.061 percent, if all other independent variables are fixed. In addition, long-term unemployment rate was a significant predictor of T2D, B = 0.057, p = 0.010 suggesting as the long-term employment rate increase by one unit, the prevalence of T2D increased by 0.057 units. The results of the multiple linear regression are presented in table 3.

Table 3: Results of regression analysis showing that long-term unemployment and no qualifications are significant predictors of type 2 diabetes in England

Independent variables	Coefficient (B)	Standard error	95% Confidence interval (B)	Significance (P)
Long-term unemployment	0.057	0.021	0.014, 0.100	0.010
Income deprivation	-0.015	0.027	-0.069, 0.038	0.570
No qualification	0.061	0.023	0.015, 0.038	0.011
Constant	3.428	0.289	2.850, 4.006	0.000
Adjusted R^2 = 38.8%				

Therefore, for every 1000 individuals experiencing long-term unemployment, an extra 0.057 percent T2D is expected if all other independent variables are fixed. However, income deprivation was not found to be a significant predictor of T2D in England.

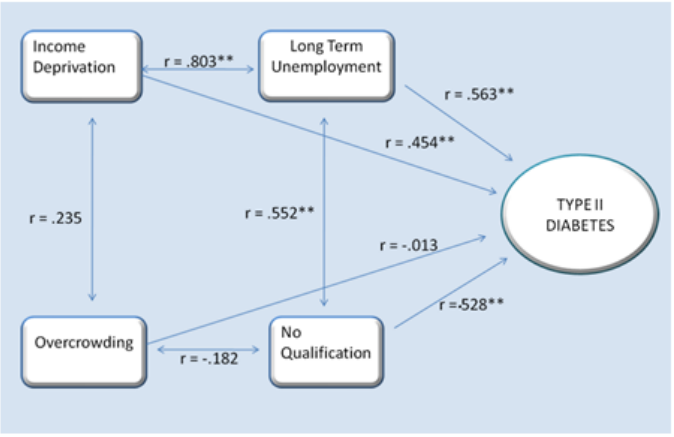
DISCUSSION

This study was set out to identify the significant socioeconomic determinants of T2D in England. The realisation that socioeconomic factors predispose the population to the risk of diabetes means that solutions to social and economic problems can indirectly lower the prevalence of diabetes. This study has offered important insights into the socioeconomic determinants of T2D, particularly identifying the long-term unemployment rate, no qualification and income deprivation as being responsible for close to 40% of the rise in the prevalence of T2D. Furthermore, the identification of the long-term unemployment rate and no qualification as major predictors of T2D in England are of great importance to policy makers in the prioritisation of resources, especially in periods of austerity and welfare reforms, when there is a reduction in public spending by the government.

Current interventions concerning T2D focus on symptoms and behavioural changes, such as diet and physical inactivity (Hwang and Shon, 2014). Arguably, the socioeconomic determinants of health are responsible for most of the behavioural changes. According to Marmot and Wilkinson (2006), the social indicators of health are considered the most significant predictors of health outcomes in the community. For instance, individuals with low levels of education and low income are more likely to consume unhealthy diets and are more physically inactive, with resultant T2D (Smith, 2007; Hill, Nielsen and Fox, 2013; Clark and Sharon, 2014). Hence, the responses to T2D should not solely depend on clinical interventions but also on improvements in quality of life.

A conceptual framework shown in figure 1 below was developed to explain a suggested link between socioeconomic determinants of health to T2D. Within the model, it is suggested that increases in interventions and the establishment of policies to reduce income deprivation, long-term unemployment and no qualifications would impact upon the prevalence of T2D in England. The bidirectional arrows between the independent variables suggest their inter relatedness based on available literature. Whereas, the asterisks indicate a significant relationship.

Figure 1: Pathway linking the socioeconomic determinants of health to T2D



Furthermore, the prevalence of diabetes is graded on the basis of the social determinants. For example, 'food insecurity' leads to a two-fold risk of diabetes in comparison with the population that consumes a healthy diet (Currie *et al*. 2009). The grading of T2D on a social basis underscores the need for

policymakers to provide practical responses to social problems. Laxity in implementing policies based on the social determinants of health is having a significant impact on efforts to combat the prevalence of T2D. Local and National governments should formulate and implement policies geared towards improving the social status of their people (Hill, Nielsen, and Fox 2013). In addition, it is important to ensure that any improvement in social status is complemented with behavioural change through health education to avoid being counterproductive. This can happen when people with improving social status resort to sedentary lifestyles that raise the risk of developing T2D.

A policy pathway to reduce the rising prevalence of T2D in England should include 'health in all policies' (HiAP) and address long-term unemployment and no qualifications in the population. A collaborative approach of 'health in all policies' can have a great impact in lowering the prevalence of T2D and other non-communicable diseases (NCDs). A key aspect of HiAP is tackling the wider social determinants of health and health inequalities. Like most other European countries, the United Kingdom has adopted this strategy and given local authorities the responsibility for public health. Commenting on this development, Buck and Gregory (2013, p. 1) argue:
"while this is a welcome move, there are as yet few resources to help local authority officers and teams identify 'what works' in improving public health and reducing health inequalities. How, then, can they decide which areas to prioritise, and through which interventions?"

It is therefore important that a health impact assessment is carried out prior to developing any policy (Dannenberg *et al*., 2008). As noted by Kemm, Parry and Palmer, (2004) most human activity is influenced by health, consequently, most public and government decisions have a tendency to impact health either positively or negatively. Therefore, interventions to improve health may be channelled towards 'non-health' areas like education, agriculture and the economy, and this can be steered by Health Impact Assessment (HIA).
Previous literature and the current study have shown that long-term unemployment is associated with unhealthy lifestyle behaviours. However, the relationship between employment and susceptibility to the risk factors of T2D is not straightforward. For example, it is arguable that the unemployed may engage in physical activities as they search for manual work and this may reduce their propensity to develop obesity. On the other hand, the low quality of life and stress related to unemployment may increase their susceptible to the risk factors of T2D (Filarski, 2014). Employment itself may not provide a complete solution as an increase in income may lead to a tendency for a lavish and sedentary lifestyle (Steckel, 2013). Work places should adopt health promotion activities, such as the provision of canteens with affordable healthy foods, free or subsidised gym membership, routine stress management courses and health education seminars.

According to Koen, Klehe, and Van-Vianen (2013), the longer an individual stays unemployed, the more likely they are to lose job-skills and the motivation to work. Gradually, this may reduce the chances of gaining gainful employment. Therefore, there is a need for relevant government agencies to ensure that the unemployed can return to work as soon as possible. This can be achieved by establishing interventions that increase the employability of such individuals (Koen, Klehe, and Van-Vianen, 2013). A pilot study conducted in 2010 (Hillage *et al*., 2012) demonstrated the cost effectiveness of helping unemployed participants return to work. Following an assessment, case management techniques, such as confidence building, motivation and vocational rehabilitation, and clinical support, including cognitive behavioural therapy, were offered to unemployed individuals. About 72% of participants returned to work within 10 to 12 weeks. The current data provide insights that championing such initiatives on a wider scale will inevitably assist more people to become 'fit for work'.

An important intervention to help reduce the impact of income deprivation on the population is to encourage individuals to tend a garden. A study exploring the major benefits of gardens estimated that community gardeners saved between $75 and $380 in procuring food each season (Hlubik, *et al*., 1994, in Armstrong, 2000, p. 320). Also, gardening within income deprived areas gave greater access to fresh vegetables and nutritious food when compared to the high intake of unhealthy foods such as sweets and fizzy drinks that are seen in non-gardening families. One study by Alaimo *et al*. 2008 examined the trend in healthy eating and found that only 17.8% of non-gardeners consumed fruits and vegetables at least five times a day, while a higher

proportion was noticed among gardeners, nearly a third.

Furthermore, multiple studies have shown that gardeners have improved mental state, especially as the gardens can serve as areas for leisure activities and exercise (Armstrong, 2000; Rappe and Kwela, 2005). For instance, a study conducted by Penninx *et al.* (2001) suggests that there was a reduction in depressive symptoms with physical activity. Therefore, it is possible that the setting up of community garden initiative can provide healthy food and improve mental health through the favourable effect of nature on emotion and exercise, with a resultant decrease in the prevalence of T2D. Besides, it a low capital venture and cost-effective method of creating self-employment since 80% of the cost is in labour (Hlubik, *et al*., 1994, in Armstrong, 2000, p. 320).

The level of literacy has a direct link to the prevalence of diabetes. Health should be emphasised in education-based policies to ensure that everyone knows the components of a healthy lifestyle (Nutbeam, 2008). People with no qualifications may lack the knowledge to make health decisions about the kind of lifestyle to lead. The solutions lie not only with policy formulators but also with the general public who should embrace the knowledge available and lead healthy lifestyles (Nutbeam, 2000). Schools give information about types of food, diseases and the importance of making healthy decisions. However, the acquisition of knowledge is not limited to schools, but it is influenced by the attitudes of individuals. It should start within families and the community prior to and during schools and college education (Thomas and Irwin, 2011). Responses to the issue of no qualification and its relationship to diabetes should be based on a broad framework that cuts across generations and institutions.

A community literacy strategy is needed to improve literacy levels (Nutbeam, 2008; Thomas and Irwin, 2011). Community programmes should mainly focus on the adults who lack the necessary skills to comprehend health-based messages. As part of corporate social responsibility and community service, the schools in each community should organise literacy programmes with the local community. The schools should provide the human resources while the members of the community should organise the venue for this highly important initiative. The government in a bid to improve literacy levels should finance these community-based programmes for the common good of the nation. Importantly, the acquisition of the necessary literacy skills through community programmes should be followed by health-based programmes (Nutbeam, 2008).

One primary limitation of the study is the non-availability of data on age, gender and ethnic groups with T2D resulted in such factors not being measured. Accurate information on these variables could be critical to link condition-specific interventions to susceptible population. Hence, it is recommended that a comprehensive data collection of these demographic characteristics are integrated into the existing process, and the collective effects of social, economic and biologic factors are investigated in future studies. A major source of uncertainty is the data used to calculate income deprivation during the initial data collection. According to Galobardes *et al*. (2006),"the personal income is a sensitive issue and people may be reluctant to provide such information". An implication for this is the possibility that the income may either be exaggerated or understated. This could be a likely explanation of why income deprivation was not found to be a significant predictor of T2D. Hence, data and findings on income should be interpreted with caution. Additionally, the socioeconomic determinants examined in this study were continuous data, and thus relatively crude. In future investigations, it might be informative to include dichotomous measures of socioeconomic determinants that are essential for group comparisons. Also, future work is required to test opposite trends in the socioeconomic factors. For instance, if increasing income level has a positive effect on decreasing T2D.

CONCLUSION

In conclusion, using multiple regression analysis, this research has shown that long-term unemployment, income deprivation and no qualifications are significant determinants of type 2 diabetes, with unemployment and no qualifications being the strongest predictors in England. The increased prevalence of type 2 diabetes in districts with low employment and high rates of no qualifications is a particular problem because it can exacerbate health inequalities. Even though the National Health Service provides universal and accessible medical services, people living with

diabetes also share some of the expense, such as prescription costs and lower productivity at work or limit academic completion, which in-turn can promote further unemployment. In order to reduce the burden of T2D on the individual and society at large, it is important to tackle 'the cause of the causes' which are the social determinants of health.

The answer to the research question (what is/are the significant socioeconomic determinant(s) of type 2 diabetes in England?), was thought to include income deprivation, long-term unemployment, overcrowding and no qualifications. However, contrary to expectations, it is now possible to state that, no relationship was found from the present study between overcrowding and the rising prevalence of T2D in England. Furthermore, this study has identified long-term unemployment, income deprivation and no qualifications, as being responsible for close to 40% of the prevalence of T2D with unemployment and no qualifications being the strongest predictors. Overall, this findings strengthens the idea that the socioeconomic determinants are strong predictors of health and this corroborate the ideas of other researchers (Marmot and Wilkinson 2006; Hill, Nielsen, and Fox, 2013a), who suggested that the social indicators of health are considered the most significant predictors of health outcomes in the community. A possible explanation of this might be the chronic stress, psychological imbalance and low motivation that arise due to these determinants, thereby, increasing the risk of unhealthy behaviours.

In general, interventions primarily target the obesogenic environment by reducing the availability of unhealthy food or environments, while making affordable healthy choices readily available. However, unhealthy choices are known to be influenced by the wider socioeconomic circumstances of the population. Therefore, interventions targeted at mitigating these public health issues may ultimately have a great impact on reducing the prevalence of T2D and other non-communicable diseases (NCDs) in England. The evidence from this study suggests that the prioritisation of resources to target these key predictors may achieve much in reducing the prevalence of T2D. By building upon the 'health in all policies', prioritising interventions to policies that ameliorate income instability, low academic attainment and employment crisis, with a resultant less stressful environment, could make individuals adopt healthy lifestyles such as healthier eating and more physical activity.

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